Method, system, playback device and recorder for duplicating multi layer record carriers

The invention relates to a playback device for a multi layer record carrier comprising video information recorded on a first layer and a second layer, the record carrier further comprising a layer transition point, the playback device comprising retrieving means for retrieving video information from the multi layer record carrier and a processing means coupled to the retrieval means, and to a recording device for recording information provided to an input on a multi layer record carrier with a first layer, a second layer and a layer transition point, the recording device comprising writing means for writing video information on the first layer and the second layer of the multi layer record carrier and a processing means coupled to the input and to the writing means and to a method for duplicating a source multi layer record carrier on a target multi layer record carrier.

Such a method is known from the standard DVD players as are currently available.

Such players allow the retrieval of the information recorded on dual layer DVD record carriers.

The player, when reading the information successively, first reads the information from a first layer, transitions to a second layer and reads the remaining information from the second layer.

The transition from the first layer to the second layer is not seamless and is located at a video cell boundary.

The information read from the record carrier is provided to the processor for decoding and the video information is provided at the output. When video information is being retrieved from the record carrier in the ordinary fashion the video information is accessed sequentially. The video information provided at the output is consequently also arranged sequentially in a single continuous data stream

When duplicating the video information on another record carrier the video information must be derived by a recording device from that single continuous data stream.

The recorder must, when the amount of data doesn't fit on a single layer, as is mostly the case with dual layer record carriers, decide where the transition from the first layer to the second layer must be performed.

A disadvantage of this method is that the recorder must analyze where cell boundaries occur and must also consider the remaining recording capacity on the first layer.

It is an objective of the present invention to provide a method where the recording device does not need to analyze the video information in order to establish an appropriate position of the layer transition point.

To achieve this objective the method comprises the steps of:

- retrieving information from a first layer on the source multi layer record carrier
- retrieving information from a second layer on the source multi layer record carrier
- retrieving a layer transition point from the source multi layer record carrier
- transferring information retrieved from the first layer and the second layer to a recording device
- transferring the layer transition point to the recording device
- recording information transferred to the recording device on the target multi layer record carrier using the transferred layer transition point to determine a layer transition point on the target record carrier.

Currently the playback device does not provide the position of the layer transition point, i.e. the location of the layer jump, to the user or other appliances. By retrieving the layer transition point from the record carrier the step of analyzing the video information can be omitted. The position of the layer transition point on the source record carrier is at an appropriate position and the choice of position of the layer transition point by the recorder can be based on this. When an offset, for instance resulting from the differences between the source record carrier and the target record carrier, exists an appropriate layer transition point can be derived from the position of the layer transition point of the source record carrier by adding the offset to this position, resulting in a new position of the layer transition point for the target record carrier. In this way the video information on the target record carrier remains divided into a section on the first layer and a section on the second layer in the same way as on the source record carrier. Thus it is also guaranteed that the layer jump happens non-seamless and at a cell boundary because those conditions were also met on the source record carrier.

A further embodiment of the method for duplicating a source multi layer record carrier is characterized in that the method comprises the step of positioning the layer transition point on the target record carrier at the same logical (physical?) address as on the source multi layer record carrier.

If no offset exist the exact same logical address of the layer transition point can be used for both the source record carrier and the target record carrier.

A further embodiment of the method for duplicating a multi layer record carrier is characterized in that the layer transition point is included in one file with the information during transfer.

Although the position of the layer transition point can be transferred from the playback device to the recording device separately from the video information it is advantageous to include the position of the layer transition point in the video information.

A further embodiment of the method for duplicating a source multi layer record carrier is characterized in that before the step of recording all information transferred to the recording device on the target multi layer record carrier the step of adjusting a maximum size of the first layer of the target multi layer record carrier is performed

By adjusting the size of the first layer of the target record carrier so that the end of the layer coincides with the position of the retrieved position of the layer transition point on the source record carrier the recorder is forced to perform the layer jump at exactly the right position. The recording capacity on the first layer of the target record carrier beyond the position of the layer transition point is not needed and by reducing the available size of the first layer an automatic layer jump is invoked.

The invention will now be described based on figures.

Figure 1 shows video information recorded on a dual layer OTP record carrier.

Figure 2 shows video information recorded on a dual layer PTP record carrier.

Figure 3 shows video information duplicated on a dual layer OTP record carrier.

Figure 4 shows video information duplicated on a dual layer PTP record carrier.

Figure 5a shows a file structure for transferring the video information from a playback device to a recorder.

Figure 5b shows a further file structure for transferring the video information from a playback device to a recorder.

Figure 6 shows a dual layer OTP record carrier prepared for duplicating another dual layer OTP record carrier.

Figure 7 shows a dual layer PTP record carrier prepared for duplicating another dual layer PTP record carrier.

Figure 8 shows a system for duplicating dual layer record carriers, comprising a playback device and a recorder.

Figure 1 shows video information recorded on a dual layer OTP record carrier.

A record carrier 3 comprises a first layer 1 and a second layer 2 on which information is recorded. The information is video information, for instance an MPEG2 video stream. Because the video information doesn't fit on a single layer the first layer 1 comprises a first section 4 comprising video information and the second layer 2 also comprises a section with video information, the second section 5. Because the record carrier shown is of the OTP type the size of the first section 4 determines the maximum size of the second section 5. This is due to the fact that the first layer 1 is read from the start of the first layer outward up to the layer transition point 6 where the reading changes to the second layer 2 and continues inward through section 5.

The physical addressing of the layers spans the maximum size of the first layer and the maximum size of the second layer. In contrast to this the logical addressing on the OTP type record carrier runs from the start of the first section 4 on the first layer 1 outward to the layer transition point 6. The logical addressing continues at the start 7 of the second section and ends at the end of the second section 5.

Consequently a third section 8 on the first layer 1 and a fourth section 9 on the second layer are comprised in the physical addressing of the record carrier but not in the logical addressing. During mastering the layer transition point 6 is determined by processing the video data and searching for an appropriate scene, for instance with a low bit rate, occurring at a cell boundary where a non-seamless layer transition can be implemented. An additional objective is often to balance the amount of video information on both layers 1,2 and thus obtaining a first section 4 and a second section5 that are approximately equal in size. This reduces the amount of padding required to fill the remaining area of the second section 5 not filled by the video information.

Figure 2 shows video information recorded on a dual layer PTP record carrier.

A PTP type record carrier comprises a first layer 20 and a second layer 21 on which information is recorded. The information is video information, for instance an MPEG2 video stream. Because the video information doesn't fit on a single layer the first layer 20

comprises a first section 22 comprising video information and the second layer 21 also comprises a section with video information, the second section 23. Because the record carrier shown is of the PTP type the size of the first section 22 has no influence on the size of the second section 23. This is due to the fact that the first layer 20 is read from the start of the first layer outward up to the layer transition point 24 where the reading changes to the start 25 of the second layer 21 and again continues outward through the second section 23 up to the end 26 of the second section 23.

The physical addressing of the layers spans the maximum size of the first layer 20 and the maximum size of the second layer 21. In contrast to this the logical addressing on the PTP type record carrier runs from the start of the first section 22 on the first layer 20 outward to the layer transition point 24. The logical addressing continues at the start 25 of the second section 23 and ends at the end 26 of the second section 23.

Consequently a third section 27 on the first layer 20 and a fourth section 28 on the second layer 21 are comprised in the physical addressing of the record carrier but not in the logical addressing. During mastering the layer transition point 24 is determined by processing the video data and searching for an appropriate scene, for instance with a low bit rate, occurring at a cell boundary where a non-seamless layer transition can be implemented. On a PTP record carrier there is no specific additional objective to balance the amount of video information on both layers 20, 21. Consequently the first section 22 and a second section 23 can have different sizes and the second section 23 can be smaller, equal or larger than the first section 22.

Figure 3 shows video information duplicated on a dual layer OTP record carrier.

When a dual layer OTP record carrier as shown in figure 1 is duplicated the video information is retrieved from logical address space of the source record carrier and provided to the recorder for recording on the target record carrier. A single stream or data file with video information is provided to the recorder and consequently the recorder must, just like during authoring, find a suitable point in the video information for the layer transition point. Figure 3 shows a layer transition point determined by the recorder close to the physical end of the first layer 30. The first layer 30 comprises a first section 32 comprising the first part of the video information. The layer transition point 33 marks the end of the first section 32 and of the logical address space of the first layer 30. The video information and the logical address space continues on the second layer, from the start 36 of the second section 37 to the end 38 of the second section 37. The recorder can of course also apply further rules for the

layer transition point for instance to ensure a balancing of the amount on video information comprised in each section 32, 37 to reduce padding. In a situation as shown in figure 3 padding would be required of the third section 39. The fourth section 34 and fifth section 35 are not comprised in the logical addressing. The drawback of this method of copying is that the video information must be processed and that potentially a relatively large section of the second layer must be padded to fill the remaining logical space of the second layer 31. Figure 4 shows video information duplicated on a dual layer PTP record carrier.

Just like the description of figure 3 figure 4 shows what happens when no special measures are taken when copying a source multiplayer record carrier to a target multiplayer record carrier.

When a dual layer PTP record carrier as shown in figure 2 is duplicated the video information is retrieved from logical address space of the source record carrier and provided to the recorder for recording on the target record carrier. A single stream or data file with video information is provided to the recorder and consequently the recorder must, just like during authoring, find a suitable point in the video information for the layer transition point. Figure 4 shows a layer transition point 43 determined by the recorder close to the physical end of the first layer 40. The first layer 40 comprises a first section 42 comprising the first part of the video information. The layer transition point 43 marks the end of the first section 42 and of the logical address space of the first layer 30. The video information and the logical address space continues on the second layer, from the start 45 of the second section 46 to the end 47 of the second section 46. The recorder can of course also apply further rules for the layer transition point for instance to ensure a balancing of the amount on video information comprised in each section 42, 46. The third section 44 and fourth section 48 are not comprised in the logical addressing. The drawback of this method of copying is that the video information must be processed.

Figure 5a shows a file structure for transferring the video information from a playback device to a recorder.

In order to avoid the mandatory processing of the video information figure 5a shows a file structure 50, 53 that comprises a first file 50 and a second file 53. The first file comprises the video information of the source multiplayer record carrier. Because the playback device only provides a single stream or file with a continues logical address space comprising both the first section 51 of the video information read from the first section on the first layer and the second section 52 of the video information read from the second section on the second layer of the source multiplayer record carrier, a second file 53 is provided by the

recorder in addition to the first file 50. The second file 53 comprises the logical address of the layer transition point. This way the recorder does no longer need to process the video information but can use the provided logical address of the original layer transition point of the source record carrier to determine the appropriate layer transition point for the target record carrier.

A constant offset in the physical address space of the target record carrier compared to the source record carrier can be easily take into account by the recorder. An advantage of a separate second file 53 is that this second file 53 can be transferred to the recorder independent of the first file 50 comprising the video information.

Because the recorder must know the position of the layer transition point before the recording of the video information has advanced to the layer transition point the second file can transferred at any time before the recorder reaches the layer transition point. The playback can thus transfer the second file 53 either before the first file 50, or concurrently with the first section 51 of the first file 50. Before the recording of the second section 52 of the first file commences the recorder must have received the second file 53. In the DVD file structure a suitable file to comprise the logical address of the layer transition point is the IFO file which also contains other information pertinent to the video information in the VOB file or VOB files.

Figure 5b shows a further file structure for transferring the video information from a playback device to a recorder.

Another possibility is to include the logical address of the layer transition information in a section 55 of the first section 56 of the file 54 comprising the first section of the video information. Shown is the situation where the section 55 comprising the logical address of the layer transition point is located at the beginning of the first section 56, but other positions in the first section 56 are also suitable. The second section 57 of the file 54 is to be recorded on the second layer of the target record carrier. Hence, before the recording of the video information comprised in the second section 57 commences the layer transition point must be established.

Figure 6 shows a dual layer OTP record carrier prepared for duplicating another dual layer OTP record carrier.

The dual layer record carrier of figure 6 comprises a first layer 60 and a second layer 61. The first layer comprises a first section 62 to record the first section 51of video information of figure 5a. The recorder has arranged for a layer transition point 63

located such that the first section 51 of video information of the file 50 of figure 5a fits exactly in the first section 62 of the first layer 60 the target record carrier.

The remaining second section 52 of the video information of the file 50 of figure 5a can be subsequently recorded in the second section 67 of the second layer 61 of the target record carrier. One mechanism to achieve this is to reduce the maximum addressing space of the first layer 60 to coincide with the logical address of the layer transition point as retrieved from the second file 53 of figure 5a. Thus, when the recorder starts recording the video information from the first file 50 of figure 5a the layer transition is automatically forced because the recorder reaches the adjusted maximum addressing space of the first layer 60, corresponding to the end of the first section 62 exactly when the recording of the video information has progressed to that point in the video information where the layer transition point was located on the source record carrier.

When reaching the maximum addressing space of the first layer 60 the recorder automatically performs a layer transition and continues recording the remaining video information from the start 66 of the second section 52 of the first file 50 of figure 5a in the second section 67 on the second layer 61. No recording in the third section 64 and the fourth section 65 will be performed since the third section 64 is beyond the adjusted maximum address space of the first layer and is consequently inaccessible for the recorder of the adjustment of the maximum address space of the first layer 60.

Because on an OTP type record carrier the recorder commence inward after the layer transition the fourth section 65 becomes inaccessible to the recorder after the adjustment of the maximum addressing space just like the third section 64.

Figure 7 shows a dual layer PTP record carrier prepared for duplicating another dual layer PTP record carrier.

The dual layer record carrier of figure 7 comprises a first layer 70 and a second layer 71. The first layer 70 comprises a first section 72 to record the first section 51of video information of figure 5a. The recorder has arranged for a layer transition point 73 located such that the first section 51 of video information of the file 50 of figure 5a fits exactly in the first section 72 of the first layer 70 the target record carrier.

The remaining second section 52 of the video information of the file 50 of figure 5a can be subsequently recorded in the second section 76 of the second layer 71 of the target record carrier. One mechanism to achieve this is to reduce the maximum addressing space of the first layer 70 to coincide with the logical address of the layer transition point retrieved from the second file 53 of figure 5a. Thus, when the recorder starts recording the

video information from the first file 50 of figure 5a the layer transition is automatically forced because the recorder reaches the adjusted maximum addressing space of the first layer 70, corresponding to the end 73 of the first section 72 exactly when the recording of the video information has progressed to that point in the video information where the layer transition point was located on the source record carrier.

When reaching the maximum addressing space of the first layer 70 the recorder automatically performs a layer transition and continues recording the remaining video information from the second section 52 of the first file 50 of figure 5a in the second section 76 on the second layer 71. No recording in the third section 74 and the fourth section 78 will be performed since the third section 74 is beyond the adjusted maximum address space of the first layer and is consequently inaccessible for the recorder of the adjustment of the maximum address space of the first layer 70.

Because on an PTP type record carrier the recorder commences outward from the start 75 of the second section 76 after the layer transition the fourth section 65 remains accessible to the recorder after the adjustment of the maximum addressing space, unlike the third section 74 of the first layer 70. The end 77 of the second section 76 is determined by the end of the video information.

Figure 8 shows a system for duplicating dual layer record carriers, comprising a playback device and a recorder.

A source dual layer record carrier 80 is to be duplicated on the target dual layer record carrier 81. A playback device 82 can access the information on the source record carrier through a basic engine 84 which performs the readout and decoding of the information read from the record carrier 80. The processor 88 is coupled to the basic engine 84 and can both issue instructions to the basic engine 84 and receive the information retrieved by the basic engine 84.Using the basic engine 84 the processor can retrieve both the video information and the logical address of the layer transitionpoint from the source record carrier 80 by first retrieving the video information from the first layer of the source record carrier 80, noting the logical address of the layer transition point, and subsequently retrieving the remaining video information from the second layer of the source record carrier 80.

The processor 88 is further coupled to a user interface 86 and to an output 90. Through the user interface 86 the user can instruct the playback device to start a duplication process, initiated by the playback device or can adjust the format of the files or data stream provided by the playback device 82 to the recorder 83. For instance a selection between the

two file formats illustrated in figure 5a and figure 5 b respectively can be achieved to ensure compatibility if different recorders require different file formats.

The file, files, or data stream comprising the video information and the logical address of the layer transition point are provided by the processor 88 via the interface 90 to the input 91 of the recorder 83. When the recorder 83 receives the file, files, or data stream comprising both the video information and the logical address of the layer transition point the input 91 provides the file, files or data stream to the processor 89.

The processor 89 is coupled to a user interface 87. Through the user interface 87 the user can instruct the recorder to start a duplication process, or instruct the recorder to initiate the transfer of the files from the playback device 82 to the recorder 83. In addition the user interface 87 can be used to adjust the format of the files or data stream accepted by the recorder 83 from the playback device 82. For instance a selection between the two file formats illustrated in figure 5a and figure 5 b respectively can be achieved to ensure compatibility if different playback devices provide different file formats.

For the duplicating process the playback device 82 performs the following steps>

- retrieving video information from a first layer on the source multi layer record carrier using the basic engine 84 under control of the processor 88 where the optical pickup is focused on the first layer.
- retrieving video information from a second layer on the source multi layer record carrier using the basic engine 84 under control of the processor 88 where the optical pickup is in this case focused on the second layer.
- retrieving a layer transition point from the source multi layer record carrier, using the basic engine 84 under control of the processor 88. The logical address of the layer transition point can be determined in several ways. The playback can retrieve the logical address of the layer transition position from an entry in the lead-in of the record carrier or can determine the position of the layer jump by noting the logical address of the layer transition point while retrieving the video information from the source record carrier. For duplication all video information must be retrieved from the record carrier and the playback will thus, in the case of a dual layer source record carrier, automatically encounter the layer transition.
- transferring all video information retrieved from the first layer and the second layer to a recording device.

The transfer can be initiated by the user through the user interface 86 of the playback device 82 or through the user interface 87 of the recorder 83. Alternatively the

transfer can be initiated through the interfaces 90, 91 of the playback device 82 and / or recorder 83 in case the playback device 82 and / or the recorder 83 are computer controlled through their interfaces, for instance in the case of IDE-interface controlled playback devices and recorders used in Personal Computers.

- transferring the layer transition point to the recording device

The transfer of the logical address of the layer transition point can be initiated by the user through the user interface 86 of the playback device 82 or through the user interface 87 of the recorder 83. Alternatively the transfer can be initiated through the interfaces 90, 91 of the playback device 82 and / or recorder 83 in case the playback device 82 and / or the recorder 83 are computer controlled through their interfaces, for instance in the case of IDE-interface controlled playback devices and recorders used in Personal Computers. It is obvious that the transfer of the logical address of the layer transition point can be transferred separate or together with the transfer of the video information.

- recording video information transferred to the recording device on the target multi layer record carrier using the transferred layer transition point to determine a layer transition point on the target record carrier.

The recorder 83 records the received video information on the target multi layer record carrier 81 by processing the video information using the processor 89. The processor 89 subsequently provides the video information in an appropriate form, as defined by the recording standard, together with other required information such as addressing information to the basic engine 85 where the information is converted into a signal suitable for recording on the target multi layer record carrier 81.

The recorder must however, in addition to recording the video information as outlined above, also ensure that the layer transition will occur at the correct position. For this the received logical address of the layer transition point from the source record carrier 80 is used to determine the logical address of the layer transition point for the target multi layer record carrier 81. To implement the layer transition point the processor 89 of the recorder 83 can either during the recording issue a layer jump command to the basic engine 84 or, before or during recording of the first layer of the target multi layer record carrier 81, adjust the maximum address space of the first layer of the target record carrier 81. When adjusting the maximum address space of the first layer the layer transition is performed automatically when the recorder reaches the adjusted end of the addressing space.